FLORENCE COPPER

FLORENCE COPPER INC.
1575 W. Hunt Highway, Florence, Arizona 85132 USA
florencecopper.com

September 22, 2020

Nancy Rumrill
Groundwater Protection Section (WTR-4-2)
US EPA, Region IX
75 Hawthorne St.
San Francisco, CA 94105

RE: Well Maintenance with CO_2 Proposal
UIC Permit No. R9UIC-AZ3-FY11-1

Florence Copper received a request for more information from the EPA regarding our letter dated September 8, 2020 proposing the use of CO_2 for well maintenance activities. Please see the attached document "Well Rehabilitation and Development Utilizing Injection of Liquid Carbon Dioxide" from Verdad Group, LLC. This document outlines the step-by-step procedures for the introduction of liquid CO_2 into the wells, and how this process rehabilitates wells. Verdad Group, LLC specializes in water well repair services; groundwater, surface water, and soil vapor sampling; and construction, maintenance, and repair of environmental treatment systems.

Florence Copper does not anticipate any issues with the use of CO_2 at our site from the proposed well maintenance activities. The mineralogy at Florence Copper's operation is such that CO_2 does not form in significant quantities as a byproduct of acid leaching activities, and therefore, subsequent buildup of CO_2 is not anticipated.

Please contact me at 520-316-3710 if you have any questions.

Sincerely,

Brent Berg
General Manager

cc: Maribeth Greenslade, ADEQ
Enclosure

Taseko

Well Rehabilitation and Development Utilizing Interval Injection of Liquid Carbon Dioxide. **Arizona CO2 Solutions, LLC: US Patent No: 10,648,306**

Summary

Mineral deposits and biofouling inside water wells can cause significant reduction of well production. Injection of Liquid Carbon Dioxide (CO2) into isolated intervals within water wells can aid rehabilitation and development efforts. Liquid CO2 remains liquid under pressure. Therefore, pressurized liquid CO2 can be pumped, as a liquid, through pipe without freezing. When liquid CO2 exits the injection pipe, it rapidly expands. The liquid CO2 mixes with groundwater and begins phasing between liquid, solid and gas, creating mechanical energy. This mechanical energy in combination with carbonic acid formation and rapid temperature change breaks the cohesion of depositional material. The mechanical and environmental change breaks down the protective biofilm surrounding bacteria, exposing it and deteriorates the colony. In addition, new wells can be effectively developed to remove additive and fine drill cuttings from consolidated fractures, unconsolidated formation and gravel pack.

Purpose

Rehabilitation

Groundwater wells under pumping conditions or inactive are susceptible to mineral deposition and or biofouling. Under pumping conditions, groundwater experiences temperature and pressure changes in the vicinity of the pump intake. These conditions can cause dissolution of ions, resulting in depositional scaling in and around the well casing and pump equipment. Biofouling is caused by iron or sulfate reducing bacteria that tend to colonize in stagnant or low yielding portions of wells. These bacteria colonies protect themselves with shell or coating of minerals and metals. Rehabilitation methodologies for scaling and biofouling in wells have historically included acid compounds and biocides, mixed, added to wells, swabbed for a period of time and pumped to waste. Generally, groundwater wells have low yield zones. Additives do not easily flow outside of casing or into fractures within low yielding zones, without positive pressure. Interval liquid CO2 injection across the entire production zone of the water well ensures equal treatment.

Development

During water well construction, additives or high pressure air assist with cutting removal. During most drilling methods, these additives and/or cuttings are pushed out into the surrounding formation. Traditional development procedures include surging, airlifting and pumping. While these methods are accepted and reliable, they can be time consuming and expensive. Interval liquid CO2 injection during the development process mobilizes residual fine sediments and additives during expansion and sublimation. If this treatment is rapidly followed with traditional development techniques, wells can be developed more efficiently and effectively.

Procedure

- Prior to liquid CO2 injection, the pump equipment is removed and the well casing or borehole should be brushed or swabbed and bailed to remove loose material from the inside of the well. This step is important so all mechanical and chemical energy created by the liquid CO2 treatment is able to extend beyond the inside of the casing or borehole.
- The injection / pressure relief interval tool is lowered on a pipe string to the bottom of the screened interval or borehole. Based on calculations of pressure required to displace water inside the injection pipe, liquid CO2 is delivered into the interval. Pipe pressure is monitored on the injection manifold at the surface.
- A mass of liquid CO2, 1.5 to 2 times the borehole volume is delivered into the interval. Mass and rate delivered into the interval is measured with a cryogenic instantaneous and cumulative flowmeter.
- The pressure after delivery is monitored at the surface until equilibrium is achieved. Pressure is held for a determined amount of time and then CO2 gas is briefly vented to the surface, away from the work area.
- The injection string is raised to the next interval the process is repeated until the entire production zone has been treated.
- The injection / pressure relief tool can then be converted to an interval airlift tool, with the addition of an airline with proper submergence. The well can also be surged and bailed. Immediately following injection.
- Pump equipment is reinstalled and the well is brought back into service.

Conclusion

Liquid CO2 interval injection in water wells degraded by mineral scaling and biofouling has proven to increase the yield of groundwater production by 40% to 60% per treatment without the need for waste water storage and neutralization. Liquid CO2 interval injection for well development sets a

baseline for efficient production. Redevelopment and rehabilitation event should be regularly scheduled for well longevity and cost efficient production.